Operation of a prototype detector for GERDA

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GERmanium Detector Array for the search of neutrinoless ββ decays of 76Ge

• Neutrino: Majorana particle?
• (A,Z) → (A,Z+2)+e+ + e−
  (e/ spectrum measured)
• Sensitivity
  - Isotope mass (M)
  - Running time (T)
  - Background (B)
  - Internal (Co(<10−6)/kg y) + External (228Th(<10−6)/kg y)

PHASE I

• Enriched 86% Ge (17.9 kg)
  - Heidelberg-Moscow (5) and IGEX (3) detectors
• 1 year data taking (FWHM=3.6 keV, c=95%) = 0.55 ct
  - No event: T0 = 3.0 × 10^8 y, m<0.24 = 0.77 eV
  - Event: T0 = 2.21 × 10^8 y, m<0.28 = 0.9 eV

Testing of the prototype detector assembly in liquid nitrogen

• Non enriched HP-Ge p-type diode refurbished at CANBERRA
  - Mechanical machining of a new groove
  - New lithium diffusion up to the groove
  - New boro inner contact implantation
  - Evaporation of a new passivation layer
  - 2.2 keV FWHM at 1.332 MeV
  (in a standard test cryostat)
• Testing sequency
  - Crystal mounted in the detector holder with HV and signal contacts
  - HV to signal resistance measurement at room temperature
  - Cooling down in LN. Up, in a standard cryostat at LNGS
  - Forward resistivity measurement: a source produces a current of 1 mA and the voltage drop is measured.
  - Test point of the preamplifier and noise level recorded as the HV is increased
  - Current source (1 mA)
  - Testing tool
  - Signal to HV resistivity (0.50-Ω)
  - Forward resistivity (few kΩ)
  - Leakage current
  - Noise
  - Energy spectrum with 60Co

Testing at CANBERRA SEMICONDUCTOR, Olen, Belgium
(in collaboration with technical staff)

• Goal: spectroscopic performance of the prototype detector assembly
• Operations
  - 14 bit/105 MHz FADC
  - Facility
  - Chemical fume hood
  - DI water supply
  - High purity chemicals
  - Clean bench
  - Cryogenic test stand (dewars flushed and filled with HP liquid nitrogen)
  - Vacuum transport and storage conditions in stainless steel, electropolished surface and satin Coating
• Resolution achieved: 2.7 keV FWHM at 1.332 MeV
• Summary: Testing of the prototype detector assembly in the radon-free test bench of the LArGe facility, LNGS

Testing in the radon-free test bench of the LArGe facility, LNGS

• Facility
  - Cryostat
  - Detector support conduction
  - Operations
  - Resolution achieved: 2.7 keV FWHM at 1.332 MeV
• Summary: Testing of the prototype detector assembly in the radon-free test bench of the LArGe facility, LNGS

Summary

• GERDA Phase I low-mass detector support and contact designs are very robust and give excellent spectroscopic performance

On going activities with enriched crystals

• Opening of Heidelberg-Moscow and IGEX detectors
• Dimensions measurement, testing and refurbishment
• Background performance in the shielded liquid argon facility (LARGE)

See GERDA – a Search for Neutrinoless Double Beta Decay, K. Kröninger and Efficiency determination of Ge-detectors by using Monte Carlo Simulations, D.Budjas

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GERDA will be situated in Hall A at LNGS. The Ge crystals will be operated in UNLAg inside vacuum-insulated cryostat.

Cooling down in LN. Up, in a standard cryostat at LNGS.

Forward resistivity measurement: a source produces a current of 1 mA and the voltage drop is measured.

Testing tool
• Signal to HV resistivity (0.50-Ω)
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